

## Economic Commission for Europe

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#### Working Party on the Transport of Dangerous Goods

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#### Tanks

## Clarification of the definition of the “Maximum working pressure” of a tank

### Transmitted by the Government of Switzerland

### Introduction

1. The purpose of this document is to make the experts aware of the definition of the "*Maximum working pressure*" (MWP) of a tank and of the differences in interpretation which its current wording implies. These differences have recently proved to be problematic, particularly within the various working parties relating to tanks for the carriage of dangerous goods (particularly those of CEN/TC296). These differences, which are sometimes fundamental, are preventing work from progressing normally.

This document aims to clarify the definition of MWP to make it unambiguous and thereby avoiding any unfortunate interpretation. In order to achieve this, it is proposing an amendment to the RID/ADR texts.

### Explanation

2. The current wording of the definition of MWP originates from the various successive amendments made to the RID and ADR regulations. However, its content does not allow to provide clear answers to the following questions:

- I. Where and in which position of the tank has the MWP to be determined?
- II. Does the static pressure relating to the substance to be transported need to be taken into account?
- III. How is the MWP determined for tanks fitted with breather devices?

3. **With regard to question I:** first of all it must be pointed out that the definition of MWP specifies a gauge pressure, i.e. the result of pressure in excess of atmospheric pressure (as mentioned in 1.2.2.3 RID/ADR for receptacles).

We are in the opinion that the MWP is the effective pressure likely to be achieved **at the top of the tank** in its **operating position**.

On the one hand, the text from 1974 for the definition of MWP referred to the value of the pressure at the top of the shell. On the other hand, the same reference is given in the definition of "*Maximum allowable working pressure (MAWP)*" for mobile tanks in 6.7.2.1 RID/ADR: "a pressure (...) measured at the top of the shell while in operating position (...)".

It is important to mention that exceptional and accidental cases must be disregarded, such as when a tank overturns, which implies other pressure conditions failing to correspond to the **maximum working pressure**.

4. **With regard to question II:** By taking the top of the tank as the reference point, we are definitely talking about the pressure generated by the vapour pressure and gas contained in the tank's ullage space. Furthermore, there is no mention currently made of static pressure in the definition of MWP in the RID and ADR. The static pressure (product height) should only be taken into account in the calculation methods used to verify the design of the tank and for the dynamic stresses which this tank is subjected to.

5. This is confirmed by the information contained in the standard *EN 13094 - Metallic tanks with a working pressure not exceeding 0.5 bar*, particularly at the level of the calculation method A.5.

According to this standard:

- the maximum working pressure is *the highest of the four pressures  $P_d$ ,  $P_r$ ,  $P_v$  and  $P_{ts}$* , where  $P_v$  is the *effective pressure to which a shell is subjected by the substance carried (including such extraneous gases as it might contain) at the design temperature, in MegaPascals (MPa)*, and
- in the calculation parameters relating to the pressures induced by the product being transported from Table A.2 of the calculation method A.5,  $P_v$  is equivalent to  $P_{vd}$  “*Vapour pressure at design temperature (gauge pressure)*”.
- according to Table A.3, the value of the static pressure  $P_{ta}$  is *calculated independently of the maximum working pressure*.

Therefore, when point c) in the definition states “to which the tank is subjected by its contents”, this is definitely referring to the pressure generated by the vapour pressure of the product being transported and gas contained **in the ullage space of the tank**. On this basis, **the product's static pressure must be disregarded**.

6. To provide greater clarity, the penultimate paragraph of the definition of MWP must be merged with the text in point c), which is relevant to it.

The idea of vapour pressure, which is referred to in point c), does not apply to the filling or discharge operations defined in points a) and b). This relates, in this case, to the partial pressure of air or other gases in the ullage space, which is likely to be achieved at the tank's maximum operating temperature as a result of a rise in its contents' temperature.

7. **With regard to question III:** As part of the successive revisions made, particularly the one introducing a reference to the prescribed opening pressure of the safety valves, no reference was made to the **breather devices**.

As already mentioned earlier in reference to standard *EN 13094*, the maximum working pressure is *the highest of the four pressures  $P_d$ ,  $P_r$ ,  $P_v$  and  $P_{ts}$* , where  $P_{ts}$  is *the opening pressure of the tank's venting system*.

Consequently, the venting systems respectively the **breather devices** must be included in the definition of the MWP.

8. Furthermore, it is proposed that the wording for compressed, liquefied or dissolved gases of Class 2 in the French version should be brought into line with the wording in the English and German versions.

9. Based on the previous explanations, we propose the following amendment to the definition of MWP.

## Proposal

10. The wording of the definition in section 1.2.1 RID and ADR should be amended as follows:

i. English

*Maximum working pressure (gauge pressure)*" means the highest of the following three pressures **likely to be reached at the top of the tank while in operating position**:

- a) The highest effective pressure allowed in the tank during filling (maximum filling pressure allowed);
- b) The highest effective pressure allowed in the tank during discharge (maximum discharge pressure allowed); and
- c) The effective gauge pressure **in the ullage space** to which the tank is subjected by its contents (including such extraneous gases as it may contain) at the maximum working temperature.

Unless the special requirements prescribed in Chapter 4.3 provide otherwise, the numerical value of this ~~working~~-pressure (~~gauge pressure~~) shall not be lower than the vapour pressure (absolute pressure) of the filling substance at 50 °C.

For tanks equipped with **breather devices or** safety valves (with or without bursting disc) other than tanks for the carriage of compressed, liquefied or dissolved gases of Class 2, the maximum working pressure (gauge pressure) shall however be equal to the prescribed opening pressure of such **breather devices or** safety valves.

(See also "Calculation pressure", "Discharge pressure", "Filling pressure" and "Test pressure");

(the 2 notes remain unchanged)

ii. French:

"*Pression maximale de service*" (pression manométrique), la plus haute des trois valeurs suivantes, **susceptible d'être atteinte au sommet de la citerne dans sa position d'exploitation**:

- a) valeur maximale de la pression effective autorisée dans la citerne lors d'une opération de remplissage (pression maximale autorisée de remplissage);
- b) valeur maximale de la pression effective autorisée dans la citerne lors d'une opération de vidange (pression maximale autorisée de vidange);
- c) pression manométrique effective **dans l'espace non rempli** à laquelle **la citerne** est soumise par son contenu (y compris les gaz étrangers **qu'elle** peut renfermer) à la température maximale de service.

Sauf conditions particulières prescrites dans le chapitre 4.3, la valeur numérique de cette pression ~~de service~~ (~~pression manométrique~~) ne doit pas être inférieure à la pression de vapeur de la matière de remplissage à 50°C (pression absolue).

Pour les citernes munies de **dispositifs de respiration ou de** soupapes de sécurité (avec ou sans disque de rupture), à l'exception des citernes destinées au transport de gaz **comprimés, liquéfiés ou dissous** de la classe 2, la pression maximale de service (pression manométrique) est cependant égale à la pression prescrite pour le fonctionnement de ces **dispositifs de respiration ou de ces** soupapes de sécurité;

(les 2 notes restent inchangés)

iii. German:

**Höchster Betriebsdruck (Überdruck): Grösster der drei folgenden Drücke, der im Scheitel des Tanks im Betriebszustand erreicht werden kann:**

- a) höchster effektiver Druck, der im Tank während des Füllens zugelassen ist (höchstzulässiger Füll-druck);
- b) höchster effektiver Druck, der im Tank während des Entleerens zugelassen ist (höchstzulässiger Ent-leerungsdruck);
- c) **im füllungsfreien Raum** durch das Füllgut (einschliesslich eventuell vorhandener Fremdgase) bewirkter effektiver Überdruck im Tank bei der höchsten Betriebstemperatur.  
Wenn im Kapitel 4.3 nichts anderes vorgeschrieben ist, darf der Zahlenwert dieses ~~Druckes Betriebsdrucks (Überdruck)~~ nicht geringer sein als der Dampfdruck (absolut) des Füllgutes bei 50 °C.

Bei Tanks mit **Über - und Unterdruckbelüftungseinrichtungen oder** Sicherheitsventilen (mit oder ohne Berstscheibe) mit Ausnahme von Tanks zur Beförderung verdichteter, verflüssigter oder gelöster Gase der Klasse 2 ist der höchste Betriebsdruck (Überdruck) jedoch gleich dem vorgeschriebenen Ansprechdruck dieser **Über - und Unterdruckbelüftungseinrichtungen oder** Sicherheitsventile (siehe auch Berechnungsdruck, Entleerungsdruck, Fülldruck und Prüfdruck).

(Die Bemerkungen 1. und 2. bleiben unverändert)

## **Justification**

11. The new wording of the definition of MWP will make it possible to avoid any interpretation and difference of opinion.

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